

REMARKS

Claims 1-13 are rejected. Claims 1 is an independent claim. Claim 1 has been amended. Claims 1-13 are pending in the application.

Reconsideration of all grounds of rejection in the Office Action, and allowance of all of the pending claims are respectfully requested in light of the following remarks.

Claims 1-13 stand rejected under 35 U.S.C 103(a) as allegedly being unpatentable over Spaeth (U.S. 5,218,223) in view of Kato (US 6,246,097) and Furuya (US 2002/0084505) and further in view of Spatscheck (JP 11-218638). Applicants respectfully traverse the rejection of claim 1.

Claim 1 as amended discloses a light receiving element for converting a light signal into an electric signal including *inter alia*, a semiconductor substrate, a photo-absorption layer, a first groove, a second groove, **wherein the light signal enters the semiconductor substrate at a substantially horizontal orientation, refracts upon entering the first groove at a predetermined angle and propagating towards the photo-absorption layer, and further refracted after being reflected by the second groove so that the light signal is propagating substantially perpendicular to the base of the semiconductor substrate.**

In contrast, Spaeth discloses an opto-electric semiconductor component having different light transmission or receiving properties than the present invention as illustrated in FIGs. 1-4, wherein a diverging optical beam propagates to a large photodetector active region. In Spaeth, the central ray of the incoming light signal is initially parallel to the base of the semiconductor substrate as illustrated in FIGs. 1- 4, and then is refracted at an angle by the entrance face 5 toward the large photodetector

active region (FIGs. 1-2, and 4). Admittedly, the first leg of the light transmission path of the present invention is disclosed (light signal enters the semiconductor substrate at a substantially horizontal orientation) in FIGs. 1-4. In an alternate embodiment, in FIG. 3, Spaeth device discloses that the incoming light signal's central ray encounters the first surface parallel to the base of the semiconductor substrate, but unlike the present invention continues to propagate parallel to the semiconductor substrate surface after passing through the entrance face 5 and then after encountering a first groove (NOT a second groove) refracts at an angle towards the large photodetector active region whereas the light signal is NOT substantially perpendicular to the base of the semiconductor substrate but propagates at an angle towards a large photodetector active region.

Spaeth fails to teach or render obvious a light receiving element wherein the light transmission or receiving properties of the present invention as recited all three light paths as illustrated in FIGs. 2 and 6 and detailed in the amended base claim, **wherein the light signal enters the semiconductor substrate at a substantially horizontal orientation, refracts upon entering the first groove at a predetermined angle and propagating towards the photo-absorption layer, and further refracted after being reflected by the second groove so that the light signal is propagating substantially perpendicular to the base of the semiconductor substrate.**

Similarly, Kato fails to teach or render obvious all three light paths as found in the present invention and has different light transmission or receiving properties than the present invention as is illustrated in FIGs. 1, 7, 8- 11, 16-19. As illustrated in Kato, FIG. 1, the light signal P1 enters parallel to the base of the semiconductor substrate, like the first leg of the present invention, but unlike the present invention continues to propagate

parallel to the semiconductor substrate surface after passing through entrance surface 110c and the first groove 110d (no refraction toward absorption layer). The light signal is then refracted at an angle towards the photodetecting portion 120 by the second groove. Like Spaeth, Kato's device's light signal path does NOT align substantially perpendicular to the base of the semiconductor substrate but propagates at an angle towards a large photodetector active region. In Figs. 7 -11, Kato's device behaves as follows; a light signals enters parallel to the base of the semiconductor substrate and continues to propagate parallel to the base of the semiconductor substrate which is unlike the present invention. The light signal continues until encountering the first groove NOT a second groove where it is refracted at an angle towards the light absorption layer 140, 240, 340. Further in FIGs. 16 – 19, Kato discloses a light receiving device that enters parallel to the base of a semiconductor substrate and then is refracted at an angle toward a photoabsorption layer after encountering the first groove. Kato fails to teach or render obvious a light receiving element wherein the light transmission or receiving properties of the present invention as recited in the amended base claim.

Another reference cited by the office action, Furuya, also fails to teach or render obvious the light transmission or receiving properties (three light paths) of the present invention as is illustrated in FIGs. 2-5 and 7. As illustrated in Furuya FIG. 2 and 3, the incoming photo signal enters parallel to the base of the semiconductor substrate, then after encountering the first groove refracts at an angle towards the absorption layer 23. In Furuya, FIG. 4, which is actually (Kato JP Pub 2000-183390), an incoming light signal enters parallel to the base of the semiconductor substrate, then after encountering the first groove refracts at an angle towards the photo absorption layer 43. Furuya fails to teach

or render obvious a light receiving element wherein the light transmission or receiving properties of the present invention as recited in the amended base claim.

Finally, Spatscheck fails to teach or render obvious the light transmission or receiving properties (light paths) of the present invention as is illustrated in the representative drawing. As can be seen in the figure, a light signal enters parallel to the base of a semiconductor substrate, continues parallel to a first groove, then refracts towards the semiconductor substrate to second groove to a third groove where it refracts away from the semiconductor substrate to a fourth groove where it refracts the light signal to once again be parallel to the base of the semiconductor substrate. In other words, the light signal never propagates toward a photoabsorption layer and hence the optical signal is never perpendicular to the base of the semiconductor substrate. Spatscheck fails to teach or render obvious a light receiving element wherein the light transmission or receiving properties of the present invention as recited in the amended base claim.

None of the references cited by the office action suggest or teach a light receiving element as set forth in the amended base claim wherein the light transmission properties (three light paths) of the present invention as illustrated in FIG. 2 and 6 and recited in the amended base claim, **wherein the light signal enters the semiconductor substrate at a substantially horizontal orientation, refracts upon entering the first groove at a predetermined angle and propagating towards the photo-absorption layer, and further refracted after being reflected by the second groove so that the light signal is propagating substantially perpendicular to the base of the semiconductor substrate,** as found in the amended base claims.

The present invention's unique light transmission properties are an improvement over the prior art cited in this office action whereas the three light paths help focus the light signal so as to "... improve a vertical-incidence angle of light signals toward the photo-absorption layer by 97° to 94° through refraction and reflection in the substrate" (Specification, page 13, line 18). Therefore, the present invention provides an improved coupling yield, which is a problem found in the Spaeth, Kato, Furuya and Spatscheck and which is demonstrated through a simulation of the present invention (FIG. 6).

The coupling yield problem, found in the prior art is that the angle of the beam incident to the absorption layer deviates substantially from the normal line (the normal line is a vertical voluntary line at one side of the absorption layer where light is incident to). If the angle deviated from the normal line becomes large, the change of the final arrival position becomes large according to the position of the beam generated from the fiber, so that the coupling yield is substantially reduced in the prior art. However, the light signal in the present invention is almost vertically incident at the absorption layer 140 (FIG 2 or 6) and the incident position and the incident height of the light signal is insensible than Spaeth, Kato, Furuya and Spatscheck, so that the coupling yield in manufacturing a light module is improved.

In the prior art each reference discloses a unique structure which dictates how light is transmitted and received. Applicants respectfully submit therefore that the combination of Spaeth, Kato, Furuya and Spatscheck fail to disclose or suggest the desirability of modifying the light paths in the prior art such that the instant amended base claim which disclose an enhanced vertical-incidence angle of light towards the photo-absorption layer would have been obvious to the artisan. In fact, combining the

references would teach away from each devices specific light transmission and receiving design.

Reconsideration and withdrawal of this ground of rejection is respectfully requested.

The other claims in this application are each dependent from the independent claim discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration of the patentability of each on its own merits is respectfully requested.

The applicants submit that the claims, as they now stand, fully satisfy the requirements of 35 U.S.C. 102 and 103. In view of the foregoing amendments and remarks, favorable reconsideration and early passage to issue of the present application are respectfully solicited.

For all the foregoing reasons, it is respectfully submitted that all of the present claims are patentable in view of the cited reference. A Notice of Allowance is respectfully requested.



Should the Examiner deem that there are any issues, which may be best, resolved by telephone communication, please contact Applicant's undersigned Attorney at the number listed below.

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